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Original Article

Relationship between alcohol consumption and age at menopause: The Korea National Health and Nutrition Examination Survey

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ABSTRACT

Objective: We used data from the 2011–2014 Korean National Health and Nutrition Examination Surveys (KNHANES) to investigate whether the age at menopause is related to alcohol consumption in South Korean women.

Materials and methods: This was a cross-sectional study of the data for 940 women who became menopausal within the 3 years preceding the KNHANES.

Results: The numbers of nondrinkers, mild to moderate drinkers, and heavy drinkers in this group were 345 (34.7%), 573 (62.2%), and 22 (3%). Body mass index (BMI), smoking, and exercise were adjusted in model 1 and age was additionally adjusted in model 2. The mean ages at menopause were 51.6 ± 0.2, 50.8 ± 0.1, and 50.4 ± 0.5 years ($p = 0.0025$) in model 1 and 51.7 ± 0.2, 51.1 ± 0.1, and 50.1 ± 0.5 years ($p = 0.0018$) in model 2 for nondrinkers, mild to moderate drinkers, and heavy drinkers, respectively. BMI, smoking, exercise, educational level, income, duration of menopause, age at menarche, age at first delivery, and gravidity were adjusted in model 3, and the respective mean ages at menopause were 51.3 ± 0.2, 50.7 ± 0.2, and 50.1 ± 0.8 years ($p = 0.0402$). The population was classified into groups using the Alcohol Use Disorders Identification Test (AUDIT) scores of <5 (n = 778), <10 (n = 108), and ≥10 score (n = 54). The mean ages at menopause according to AUDIT score were 51.3 ± 0.1, 50.5 ± 0.3, and 50.4 ± 0.4 years ($p = 0.0222$, model 1), 51.4 ± 0.1, 50.8 ± 0.3, and 50.8 ± 0.3 years ($p = 0.0261$, model 2), and 51.1 ± 0.1, 50.6 ± 0.4, and 49.5 ± 0.6 years ($p = 0.0241$, model 3) respectively.

Conclusion: In Korean women, alcohol consumption was associated with younger age at menopause. A higher AUDIT score was also related to younger age at menopause.

Introduction

Natural menopause is commonly defined as the time when a woman has experienced 12 consecutive months of amenorrhea that is not related to any surgical or drug treatment [1–3]. The average age at natural menopause has consistently been estimated at between 50 and 51 years [2,4,5]. Menopause increases the risk of many chronic health problems. An early decline in estrogen production can translate into a substantially greater risk of osteoporosis, obesity, cardiovascular disease, and earlier onset of Alzheimer's disease [6–9]. At the population level, earlier onset of menopause may also lead to greater demand for medical care and an earlier start for hormone therapy. These may increase the financial burden and the risk of breast cancer.

It is thought that genetic factors determine the age at menopause for about 50% of women [10]. However, in addition to genetic factors, many other factors have been investigated in relation to the age of menopause, including obesity, parity, age at menarche, pattern of menstrual cycles, smoking, socioeconomic level, alcohol intake, educational level, diet, marital state, and use of contraceptives [11–13]. The associations between these factors and age at menopause are inconsistent between studies [14].

Information about the potential effects of alcohol is less clear because of the diversity of alcoholic consumption and the difficulty in determining a threshold consumption frequency. Chronic alcohol abuse is one risk factor for osteoporosis, and the World

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Cancer Research Fund/American Institute for Cancer Research has estimated that >40% of postmenopausal breast cancer could be prevented by reductions in alcohol, excess body weight, and physical inactivity [15,16]. Increased alcohol consumption is reported to have a broad range of detrimental systemic effects. However, there are few studies of the association between age at menopause and alcohol consumption. In this study, we used the data from Korean National Health and Nutrition Examination Surveys (KNHANES) to examine whether there is a relationship between alcohol consumption and age at menopause in Korean women.

Materials and methods

This study was based on data collected during the 2011–2014 KNHANES, which has been conducted since 1998 by the Division of Chronic Disease Surveillance under the Korea Centers for Disease Control and Prevention. KNHANES is a population-based cross-sectional survey designed to assess the health-related behavior, health condition, and nutritional state of Koreans (http://knhanes.cdc.go.kr/) [17]. A field survey team that included doctors and nurse examiners traveled with a mobile examination unit and performed interviews and physical examinations. The survey comprised a health interview, nutritional survey, and health examination survey. The survey collected data by household interviews and by direct standardized physical examinations conducted in specially equipped mobile examination centers. During 2011–2014, 33,552 noninstitutionalized South Korean people participated in KNHANES. Among the 33,552 participants, 18,291 were women and 5799 of these female participants were in the menopausal state. We chose 940 women of the 5560 menopausal women, minus 239 who did not complete the examination surveys, who had become menopausal within the preceding 3 years for blocking the bias from inaccurate memories.

Data regarding age, smoking history, exercise, place of residence, marital status, occupation, educational level, household income, number of pregnancies, duration of menopause, age at menarche, and age at first and last delivery were collected during the health interview. During the physical examination, height, weight, and waist circumference were measured. Standing height was measured with the subject facing directly forward with the shoes off, feet together, arms by the sides, and the heels, buttocks, and upper back in contact with the well. Waist circumference was measured to the nearest 0.1 cm at the midpoint between the iliac crest and the costal margin at the end of a normal expiration. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Written informed consent was obtained from all participants before the survey, and approval for this study was obtained from the Institutional Review Board of the Catholic University of Korea, Bucheon, Korea. Menopause was defined by health interview as having no menstruation during the past 12 months. Smoking history was categorized into the two groups: current or ex-smoker and nonsmoker.

The subjects were classified into three groups according to the amount of alcohol consumed per day in the month before the interview: nondrinkers, mild to moderate drinkers (<30 g/day), and heavy drinkers (≥30 g/day). The population was classified into three levels according to the score on the Alcohol Use Disorders Identification Test (AUDIT): 0–4, 5–9, ≥10. High-risk drinking was defined as drinking ≥5 cups or glasses of beer, wine, or hard liquor during one session. Individuals with a household income in the lowest quartile were designated as the low-income group. The educational level was classified as low if the respondent did not finish education beyond middle school (i.e., beyond ninth grade). Regular exercise was defined as strenuous physical activity performed for at least 20 min at a time at least three times per week. Data regarding gravidity was only collected during 2011–2013.

Statistical analyses were performed using the SAS survey procedure (ver. 9.3; SAS Institute, Cary, NC) to reflect the complex sampling design and sampling weights of the KNHANES, and to provide nationally representative prevalence estimates. The procedures included unequal probabilities of selection, oversampling, and nonresponse. Participant characteristics were described by using means ± standard error (SE) for continuous variables, and percentages and SE for categorical variables. For each variable, analysis of variance was used to analyze the association with age at menopause. Analysis of covariance was used to examine the association between drinking habit and age at menopause. We first adjusted for BMI, smoking, and exercise (model 1), and then adjusted for age, BMI, smoking, and exercise (model 2), and BMI, smoking, exercise, educational level, income, duration of menopause, age at menarche, age at first delivery, and gravidity (model 3). The p values were two-tailed, and $p < 0.05$ was considered significant.

Results

The mean age of the 940 menopausal women was 52.6 ± 0.1 years, and 841 (86.1%) were older than 50 years. Two hundred ninety-nine women (32.3%) had a BMI ≥25 and 425 (44.5%) had a waist circumference ≥80 cm. All of the women included in this study had experienced menopause within 3 years of the study, and the mean duration of menopause was 1.55 ± 0.04 years. The baseline characteristics of the study population are shown in Table 1. An older age at menopause was related to a waist circumference ≥80 cm ($p = 0.0073$) and a BMI ≥25 ($p = 0.0164$) (Table 2). Women who worked had a younger age at menopause compared with those who did not work ($p = 0.0235$). Women with a middle school or lower educational level ($p < 0.0001$) had an older age at menopause. The number of pregnancies was related to the age at menopause ($p = 0.0093$). Age at menopause was not related to smoking, exercise, place of residence, or living with one's spouse.

Greater consumption of alcohol was related to a younger age at menopause (Table 3). A higher AUDIT score was also related to a younger age at menopause. A significant effect of age at menopause classified according to alcohol consumption was found in three models. Model 1 was adjusted for BMI, smoking, and exercise ($p = 0.0025$), model 2 was adjusted for age, BMI, smoking, and exercise ($p = 0.0018$), and model 3 was adjusted for BMI, smoking, exercise, educational level, income, duration of menopause, age at menarche, age at first delivery, and gravidity ($p = 0.0402$). The age at menopause did not differ significantly between the high-risk and non-high-risk drinking groups.

Table 1
Baseline characteristics of the study population (n = 940).

Characteristics	Mean or Percentage ± SE
Age (y)	52.6 ± 0.1
BMI (kg/m^2)	23.9 ± 0.1
Waist circumference (cm)	79.6 ± 0.4
Age at menarche (y)	15.4 ± 0.1
Age at first delivery (y)	25 ± 0.1
Age at menopause (y)	51.1 ± 0.1
Duration of menopause (y)	1.55 ± 0.04
0 (%)	19.2 (1.6)
1 (%)	29.2 (1.8)
2 (%)	29.4 (1.7)
3 (%)	22.2 (1.7)

BMI = body mass index.

Table 2
Analysis of factors potentially associated with age at menopause.

Parameter	n = 940 (%) Unweighted n (%)	Age at menopause (y) (Mean ± SE)	*p*
Age (y)			<0.001
<50	99 (13.9)	46.6 ± 0.2	
≥50	841 (86.1)	51.8 ± 0.1	
BMI (kg/m^2)			0.0164
<25	641 (67.7)	50.9 ± 0.1	
≥25	299 (32.3)	51.5 ± 0.2	
Waist circumference (cm)			0.0073
<80	514 (55.5)	51.4 ± 0.2	
≥80	425 (44.5)	50.8 ± 0.1	
Smoker (ex or current)			0.3845
No	889 (93.7)	50.7 ± 0.5	
Yes	42 (6.3)	51.1 ± 0.1	
Regular exercise			0.0613
No	748 (80.3)	51.2 ± 0.1	
Yes	192 (19.7)	50.7 ± 0.2	
Place of residence			0.0589
Rural	200 (23.4)	51.5 ± 0.3	
Urban	740 (76.6)	51 ± 0.1	
Living with spouse			0.172
No	119 (13.1)	51.5 ± 0.3	
Yes	821 (86.9)	51 ± 0.1	
Occupation			0.0235
No	390 (40.5)	51.4 ± 0.2	
Yes	550 (59.5)	50.9 ± 0.1	
Education			<0.0001
Less than middle school	433 (49.8)	51.9 ± 0.2	
High school or more	507 (50.2)	50.3 ± 0.2	
Income			0.1104
Lowest quartile	90 (10.6)	51 ± 0.1	
Other	841 (89.4)	51.9 ± 0.2	
Gravidity (n)[a]			0.0093
0	3 (0.3)	49.8 ± 1.2	
1	70 (9.8)	50.6 ± 0.3	
2	460 (63.0)	50.8 ± 0.2	
3	181 (26.9)	51.8 ± 0.3	
Drinking habit			0.0033
Non-drinker	345 (34.7)	51.6 ± 0.2	
Mild to moderate drinker	573 (62.2)	50.8 ± 0.1	
Heavy drinker	22 (3)	50.5 ± 0.5	
High-risk drinker			0.5437
No	578 (95.9)	50.5 ± 0.5	
Yes	17 (4.1)	50.8 ± 0.1	
AUDIT score			<0.0001
0–4	778 (80.3)	51.3 ± 0.1	
5–9	108 (13)	50.5 ± 0.3	
≥10	54 (6.7)	50.4 ± 0.4	

BMI = body mass index.
p Values were calculated using analysis of variance.
[a] Data was collected during 2011–2013.

Discussion

A few studies have evaluated the relationship between alcohol consumption and the age at menopause. Women who consumed alcohol in our study had a younger age at menopause, and higher alcohol consumption was related to a younger age at menopause.

The mechanisms about relationship between alcohol intake and age at menopause are not fully understood. Alcohol intake was correlated with higher levels of follicle-stimulating hormone (FSH) in women of childbearing age which have been associated with ovarian damage [18,19]. And Faut et al. also reported that alcohol drinking was related with oxidative stress which have been associated with ovarian damage in female rats [20].

However, most other studies found alcohol consumption had a positive correlation with age at menopause or was not associated with age at menopause [21–26]. Kinney et al. reported that alcohol consumption was not related to any ovarian age indicator (antral follicle count, follicle-stimulating hormone, inhibin B, and estradiol) in the data for 188 women [21]. In the Shanghai Women's Health Study of Dorjgochoo et al. (n = 33,054), age at menopause was not associated with alcohol consumption [22]. Brett et al. analyzed the data from the National Health Interview Survey (n = 3307) and reported that women who consumed alcohol were less likely to be postmenopausal than were those who never drank [23]. The odds ratio (OR) of menopause was 0.7 (95% confidence interval (CI), 0.5–1.0) for drinkers compared with nondrinkers. Cooper et al. evaluated data from the Third National Health and Nutrition Examination Survey (n = 33,994) and reported that alcohol use tended to be associated with a lower likelihood of being postmenopausal [24]. The ORs for being postmenopausal were 0.5 (95% CI, 0.3–1.0) and 0.5 (95% CI, 0.2–1.1) for women who consumed <3 drinks per week and ≥3 drinks per week, respectively.

Our findings differed from those of previous studies possibly because of differences in ethnicity, types of alcohol consumed, climate, and cultural determinants. Variances in the amount and type of alcohol consumed also may be reasons for inconsistent conclusions. Most studies have not included a description of the types of alcohol consumed. Alcohol consumption was rare in several of the study cohorts mentioned above and that may have interfered with the ability to obtain precise estimates.

We used the AUDIT to obtain more information about alcohol consumption. In our study, the age at menopause was inversely associated with the AUDIT score. AUDIT was developed from a World Health Organization collaborative project as a screening instrument for hazardous and harmful alcohol consumption [27]. It

Table 3
The relationship between drinking habit and age at menopause.

Parameter	Model 1		Model 2		Model 3	
	Age at menopause (Mean ± S.E) (y)	*p*	Age at menopause (Mean ± S.E) (y)	*p*	Age at menopause (Mean ± S.E) (y)	*p*
Drinking habit		0.0025		0.0018		0.0402
Non-drinker	51.6 ± 0.2		51.7 ± 0.2		51.3 ± 0.2	
Mild to moderate drinker	50.8 ± 0.1		51.1 ± 0.1		50.7 ± 0.2	
Heavy drinker	50.4 ± 0.5		50.1 ± 0.5		50.1 ± 0.8	
High-risk drinker		0.4988		0.1788		0.6525
No	50.8 ± 0.1		51 ± 0.1		50.2 ± 0.9	
Yes	50.4 ± 0.6		50.2 ± 0.6		50.6 ± 0.2	
AUDIT score		0.0222		0.0261		0.0241
0–4	51.3 ± 0.1		51.4 ± 0.1		51.1 ± 0.1	
5–9	50.5 ± 0.3		50.8 ± 0.3		50.6 ± 0.4	
≥10	50.4 ± 0.4		50.8 ± 0.3		49.5 ± 0.6	

AUDIT, Alcohol Use Disorder Identification Test; *p* values were calculated by Analysis of Covariance (ANCOVA); Model 1 was adjusted for body mass index, smoke, exercise, Model 2 was adjusted for age, body mass index, smoke, exercise and Model 3 was adjusted for body mass index, smoke, exercise, education, income, duration of menopause, age at menarche, age at first delivery, and gravidity.

is a 10-item questionnaire that covers the domains of alcohol consumption, drinking behavior, and alcohol-related problems. Responses to each question are scored from 0 to 4, giving a maximum possible score of 40. Among those classified as having hazardous or harmful alcohol use, 92% had an AUDIT score of ≥8, and 94% of those with nonhazardous consumption had a score of <8. In our study, few women had an AUDIT score of ≥20, and we divided the AUDIT score into three levels (0–4, 5–9, and ≥10).

One of the strongest and most clearly demonstrated risk factors for early menopause is cigarette smoking. In most studies of smoking, age at menopause is consistently inversely related to smoking [21,22,28]. Dorjgochoo et al. reported that the mean age at natural menopause was significantly younger for current smokers (n = 1167; 48.4 ± 4.1 years) than for never-smokers (n = 31,615; 49.2 ± 3.7 years) ($p < 0.01$) [22]. Kaczmarek analyzed data from a cross-sectional survey in Poland (n = 7183). The median age at menopause was 1.2 years earlier for current smokers compared with nonsmokers and 0.3 years earlier compared with past smokers (p for trend = 0.00007) [25]. However, in our study, age at menopause was not related to smoking. The number of smokers was small, only 42 (6.3%), and this was too small for a precise analysis. The study by Abdollahi et al. of 804 menopausal women in Iran also found no significant association between smoking and age at menopause [29], although only four of the women (0.5%) were smokers.

We also found that age at menopause was significantly related to the number of pregnancies; that is, a greater number of pregnancies was associated with an older age at menopause. This finding is similar to those of previous studies. Kaczmarek reported a trend for older age at menopause with increased number of children ever born to a woman ($p = 0.04$) [25]. Abdollahi et al. also found that older age at menopause was related to a greater number of pregnancies and deliveries [29]. The mean ages at menopause were 46.26 ± 4.9 years in nulligravida and 47.97 ± 4.4 years in multigravida with 5–9 pregnancies, and 49.96 ± 4.27 years in those with ≥10 pregnancies ($p < 0.01$).

Most studies of the associations between age at menopause and household income and educational level have showed inconsistent results. We found that older age at menopause was related to low educational level. Some investigators have found that age at menopause was not associated with income or educational level [24,29,30], whereas others have reported an association between younger age at menopause and low educational level [23,25].

The main strength of the present study lies in the nationally representative sample of Koreans and the sufficient power to investigate these relationships. Another strength is the availability of data about relevant confounding factors. There are also a few limitations in this study. First, to obtain more precise information about the age at menopause of the participants, we chose only women who had experienced menopause within the past 3 years. This reduced the number of participants and weakened the power of our study. Second, the present study was cross sectional. An obvious problem with cross-sectional studies is that exposure and outcome are measured at the same time and that their interrelated sequences are unknown. Many studies have shown a relationship between age at menopause and various factors. However, most have been purely observational. There have been insufficient analyses of mechanisms by which these factors are associated with age at menopause. Future studies should focus on identifying these mechanisms, and may help control the health problems related to menopause and the age at which it occurs.

Unlike previous studies, this study has demonstrated an inverse relationship between the age at menopause and alcohol consumption. However, more large-scale studies are needed to fully understand this relationship.

Contributors

Jeong In Choi and Hae Nam Lee were responsible for the study concept and design wrote the manuscript.

Kyung-do Han was responsible for the study design and statistical analysis of the results.

Dae Woo Lee, Min Jeong Kim and Yeon Joo Shin contributed to data analysis.

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Conflicts of interest

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